

The Surfer Health Study

Surfrider Foundation collaborated with scientists at Southern California Coastal Water Research Project (SCCWRP); University of California, Berkeley, School of Public Health; and Soller Environmental to conduct a first-of-its-kind study of surfer health during both wet and dry conditions. The [Surfer Health Study](#) (SHS) built upon the work of [Dwight, et al](#) (2004) who performed a study of surfer health in north Orange County and Santa Cruz County during the winters of 1998 and 1999. That study suggested that discharging untreated urban runoff onto public beaches can pose health risks, and that those risks increased during wet weather.

To attempt to quantify those risks and examine the relationship between water quality and a range of reported health outcomes, surfers were recruited both on the beach and online and their surfing sessions and health effects were tracked during the winters of 2013-2014 and 2014-2015. The study was conducted at two San Diego-area beaches, Ocean Beach and Tourmaline Surfing Park. These beaches were selected because of their year-round popularity as surf spots, and also because each location had a nearby source of stormwater and dry weather urban runoff. San Diego River discharges to the ocean at the north end of Ocean Beach and Tourmaline Creek/Storm Drain discharges to the ocean near the primary surfing area at Tourmaline Surfing Park in Pacific Beach.

Ocean water samples were collected and analyzed daily during the study period at four locations at Ocean Beach and at two locations at Tourmaline. These samples were analyzed for fecal indicator bacteria (FIB) enterococcus, total coliform and fecal coliform as specified by California and EPA standards. In addition, water samples were collected during rain events from San Diego River and Tourmaline Creek. These samples were analyzed for FIB, human pathogens such as norovirus, and genetic markers of human and animal fecal pollution.

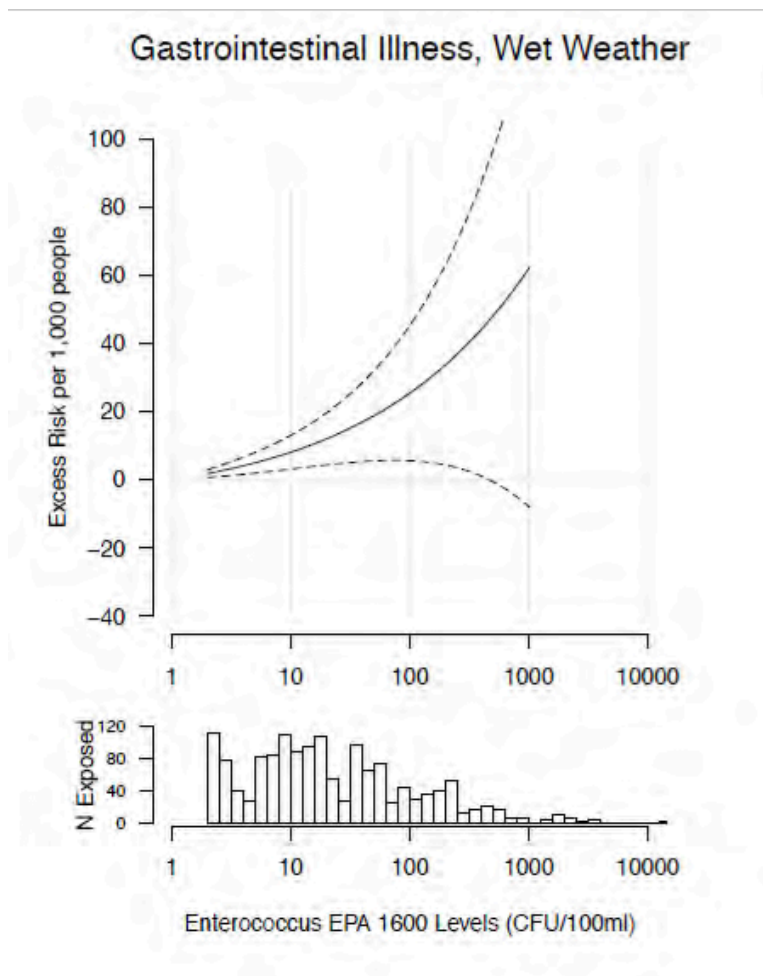
Surfers reported data on their surf sessions (date, time, length of session, location, surf and weather conditions) and illness or other health symptoms using a smartphone app developed for the project or via a website. Participants received text message or email reminders weekly to enter their data for the previous week. Scientists at SCCWRP and UC Berkeley evaluated the data and determined if correlations existed between water quality and reported illnesses, during both dry and wet weather.

The goals of the study were to answer the following questions:

- Is surfing associated with an increased rate of illness?
- Are illness rates higher when surfing following wet weather compared to dry weather?
- What is the association between water quality and illness following wet weather events?
- What level of water quality corresponds to the same risk of illness as current water quality objectives?

The general answers were:

- Illness (gastro-intestinal illness, rashes, infected cuts and a variety of other infections) rates increased when surfers went surfing, as opposed to when they didn't enter the ocean.
- Illness rates were higher when surfing during wet weather (defined as the first day of rain followed by the next three days) compared to surfing during dry weather.
- There was a statistically-significant correlation between water quality (as measured by enterococcus and other FIB) and illness rates during wet weather. In other words, the higher the FIB concentrations, the higher the chance of illness.

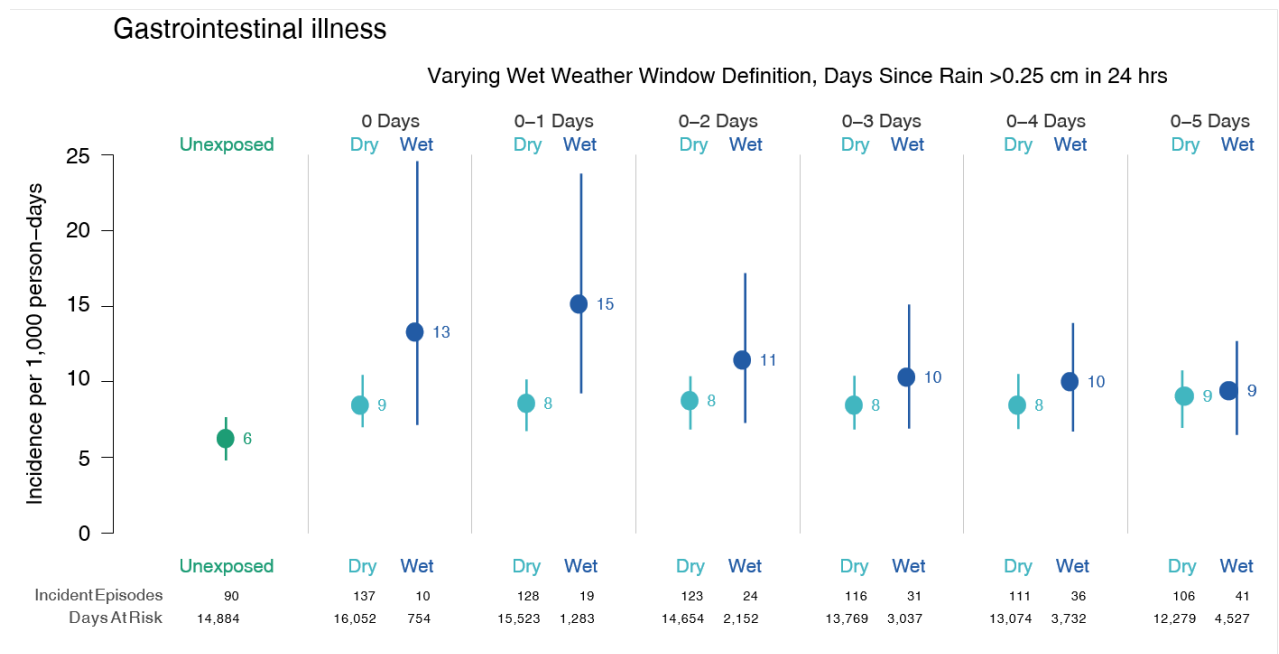


- EPA's current water quality objectives predict about 32 excess cases of GI illness when 1000 swimmers are exposed to water that contains FIB at the health warning level. At this same level, the Surfer Health Study indicated that surfers participating in the study experienced about 12 excess cases of GI illness per thousand surf sessions. This implies that higher FIB concentrations would be required to reach the illness rates predicted by EPA.

- Although the study focused on GI illness, the rates of several other types of illnesses also increased with both dry weather and wet weather exposure. The largest relative increase in illness rates were for earache or infection and infection of open wounds.

Other significant findings of the study were:

- The “72 hour rule” (stay out of the water for 72 hours after a rain event) was validated by the study. Illness rates were highest when surfing during rain and the first day after the rain. Illness rates decreased with each day following rain, declining to near baseline levels after 3 days.



- Location matters. At Ocean Beach, FIB concentrations during and following rain events steadily decreased from Dog Beach (near the mouth of the San Diego River) southward to the Ocean Beach Pier. If you do surf during wet weather, try to stay away from locations where runoff enters the ocean.



Figure 1. Map of (A) two popular surfing beaches in San Diego, CA with insets of (B) Tourmaline Surfing Park and (C) Ocean Beach showing study sampling locations, including stormwater discharges for Tourmaline Creek (TDIS) and San Diego River (OBDIS).

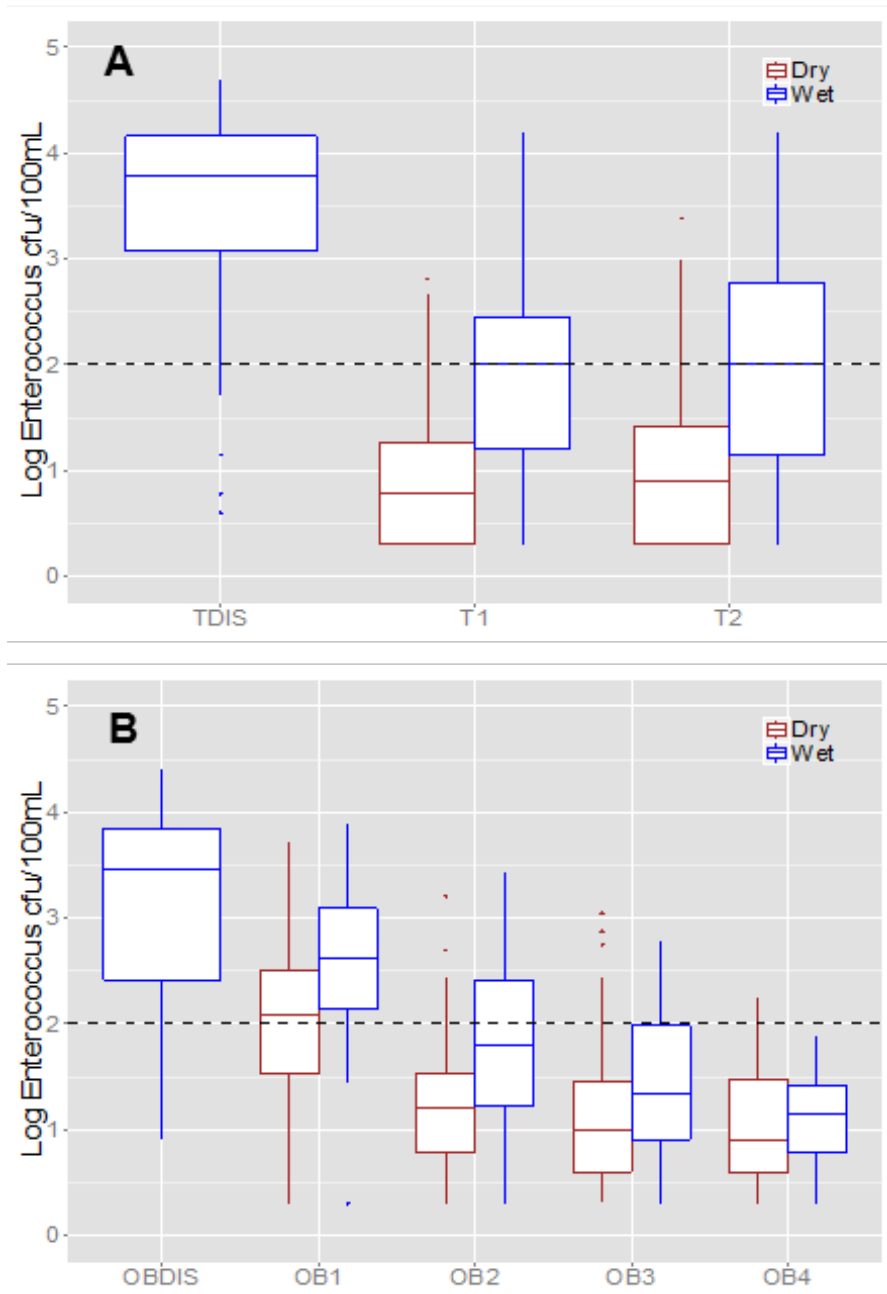


Figure 2. Box plots¹ of cultured *Enterococcus* concentrations in wet² versus dry weather at (A) Tourmaline Surfing Park and (B) Ocean Beach³ during the 2013-14 and 2014-15 wet season.

¹ Boxes represent median, 25 and 75 percentile, 3 times the standard deviation, and individual outlier samples. ² Wet weather defined by the County Health Department as >2.5 mm precipitation in 24 hr plus three days. ³ See Figure 1 for sampling site locations.

- During rain events, human pathogens were nearly always detected in the discharges. Norovirus was detected in 96% of the samples from San Diego River and 72% of the samples from Tourmaline Creek. HF 183, a human source marker, was detected in all samples from San Diego River and 95% of the samples from Tourmaline Creek. Possible causes of this include integrity problems with the sewer system, sewer/storm drain cross-connections, or impacts from homeless populations.

It also should be noted that inherent differences exist between previous swimmer health studies and the [Surfer Health Study](#). These include:

- Surfer health and resistance to illness may differ from the non-surfer beachgoing population.
- The Surfer Health Study included only people 18 and over, whereas previous swimmer health studies have included those under 18. Children (especially young children) are known to be more susceptible to illness than adults.
- Although water quality was measured at the same location (ankle to knee deep water) in both swimmer and surfer health studies, the primary exposure location in the SHS was further seaward (where water quality was presumably better) than in the swimmer health studies.

As a result of the study, policy managers at local, regional and state levels will evaluate whether it is appropriate to make any changes in beach water quality standards or public health notifications. The City of San Diego and other appropriate entities are conducting investigations in the San Diego Creek and Tourmaline Creek watersheds to try to identify and eliminate sources of fecal pollution.

Surfrider Foundation will continue to be involved in these policy discussions and investigations to work towards improved water quality and public health protection.